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Micrometrical Measures of the Diameters of Ceres, Pallas, and Vesta, made with the 36-inch Refractor of the Lick Observatory. By E. E. Barnard.

In *Astronomy and Astro-Physics* for May 1894 I have given the preliminary results of a series of measures of the diameters of three of the larger asteroids: *Ceres* (1), *Pallas* (2), *Vesta* (4).

In the present paper the details of these measures are given. I regret that much bad weather in the spring of the year prevented as many observations of these objects as I had intended to make. It requires good atmospheric conditions to see and measure these small bodies well.

It was intended to include *Juno* (3) in the list, but though I examined it several times I could not get a satisfactory image to measure, from the disturbed condition of the atmosphere. A series of measures of the satellites of *Uranus* and of the Ball and Ring system of *Saturn* were being carried on at this time also, and took up the best nights. No actual measures of *Juno* were made therefore, but I hope to get good measures of it as soon as it is again favourably placed for observing. I hope also to continue the measures of *Ceres*, *Pallas*, and *Vesta*.

Of these last *Ceres* was measured on nine nights, and *Pallas* and *Vesta* on five nights each.

In my paper on this subject in *Astronomy and Astro-Physics* I called attention to the fact that previous measures and estimates had placed *Vesta* as the largest of the asteroids. The present measures give that position to *Ceres*. This has created some surprise, but the question is clearly settled, not only by the measures themselves, but by the fact that, though *Ceres* was more distant than *Pallas* or *Vesta*, it appeared some two times larger in the telescope than either of them. This was very evident, as they were examined on the same nights and at the same time

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turning the telescope from one to the other. It should therefore be accepted without hesitation that *Ceres* is the largest of the asteroids.

Following are the measures which have been made with the filar micrometer of the 36-in. equatorial.

The first column gives the measured diameter; the second gives this quantity reduced to the mean distance of *Ceres* from the Sun, viz. 2.7673.

<i>Ceres.</i>			
	Obs'd.	At Δ 2.7673.	Deviation from Mean.
^{1894.} Mar. 11	0.95	0.55	-0.13
12	0.75	0.44	-0.02
25	0.72	0.43	-0.01
Apr. 1	0.73	0.44	-0.02
9	0.58	0.36	+0.06
16	0.60	0.39	+0.03
23	0.59	0.40	+0.02
30	0.58	0.40	+0.02
May 7	0.47	0.34	+0.08
		<hr/> 0.417	

or at distance unity 1''.155.

<i>Pallas.</i>			
	Obs'd.	At Δ 2.7673.	Deviation from Mean.
^{1894.} Feb. 25	0.75	0.34	-0.10
26	0.59	0.26	-0.02
Mar. 11	0.44	0.21	+0.03
12	0.46	0.21	+0.03
25	0.40	0.20	+0.04
		<hr/> 0.244	

or at distance unity 0''.675.

<i>Vesta.</i>			
	Obs'd.	At Δ 2.7673.	Deviation from Mean.
^{1894.} Mar. 11	0.38	0.23	-0.04
12	0.46	0.22	-0.03
25	0.33	0.16	+0.03
Apr. 1	0.39	0.20	-0.01
9	0.29	0.15	+0.04
		<hr/> 0.194	

or at distance unity 0''.536.

These values of the diameters would be represented in miles by—

Ceres 520 miles
Pallas 304 „
Vesta 241 „

These differ somewhat—and in the case of *Ceres* considerably—from the preliminary values (from the first three observations) as given in the paper in *Astronomy and Astro-Physics* referred to, viz.

Ceres 599 miles (0".481 at Δ 2.7673 or 1".330 at Δ 1)
Pallas 273 „ (0".211 „ „ 0".605 „)
Vesta 237 „ (0".191 „ „ 0".527 „)

The first few measures of *Ceres* were doubtless somewhat too large, as is shown in the series for that planet. We must remember, however, that the entire quantities themselves that are measured are very small in consideration of the great distance of the objects from us, a tenth of a second at the mean distance of *Ceres* being represented by 125 miles.

I have refrained from giving the probable errors of these results, for such seldom mean anything except to show the accordance of the measures among themselves. I have instead inserted a column of "deviations from the mean."

I think another year's measures will give fairly satisfactory diameters to these three asteroids—better, I believe, than can be obtained by any other method.

Mr. E. J. Stone's values for the diameters of these asteroids, viz.

Ceres 196 miles
Pallas 171 „
Vesta 214 „

were deduced from measures of *Ceres* and *Pallas* by Herschel and Lamont, whose instruments were certainly inadequate to deal with such quantities as the diameters of the minor planets.

Mount Hamilton :
1894 August 28.

Note on Professor Turner's Paper on the Reduction of Measures of Photographic Plates (Monthly Notices, vol. liv., 1893 November). By F. W. Dyson, M.A.

In Note IV. of this paper several small errors are made, which can easily be corrected in the margin, but which deserve to be noticed on account of the importance of the subject.

On p. 23, after "The coefficient of y_1 in the numerator x_2 is"

$$\begin{aligned} &\text{read } (-\sec P_2 \sin \overline{A_1 - A_2})/D \\ &= -X_{12} \cot P_1 \dots \dots \dots (14) \\ &\text{T T 2} \end{aligned}$$